CLAIMS

1. A method of measuring properties of particles, comprising the steps of:

generating a beam of radiation (IB) which is propagated along a principal direction (z),

illuminating with the beam (IB) an observation region (MR) which is occupied or transited by a plurality of particles (B), a portion of the beam (IB) giving rise to radiation (SW) which is scattered by scattering interaction of that portion of the beam (IB) with the particles (B), and another portion (TB) being transmitted substantially undisturbed along the principal axis (z) through the observation region (MR), and

detecting, in a plane (M) disposed on the propagation direction (z), a plurality of radiation intensity values which are determined by the interference between the scattered radiation (SW) and the transmitted radiation (TB),

characterized in that it further comprises the steps of:

identifying systems of interference fringes associated respectively with the individual particles (B) in which the interference pattern is affected by a phase delay of the scattered radiation (SW) relative to the transmitted radiation (TB), the delay being determined by the interaction of the radiation beam (IB) with the particles (B), and

determining the properties of the particles (B) on the basis of the fringes that are affected by the phase delay.

2. A method according to Claim 1 in which the identification of the interference fringe systems comprises a determination of the fractional order at the centre relative to the individual fringe systems.

3. A method according to Claim 1 or Claim 2 in which the identification of the interference fringe systems comprises a

determination of the depth of intensity modulation relative to the individual fringe systems.

4. A method according to any one of Claims 1 to 3 in which the radiation beam (IB) has a plane wave front.

5. A method according to Claim 4 in which the detection plane (M) is disposed at a predetermined distance z_M from the observation region (MR) such that the relationship $z_M > a^2 / \lambda$ is valid, where λ is a characteristic value for the wavelength of the radiation used and a is dimension which is characteristic of the particles contained in the observation region (MR).

6. A method according to any one of Claims 1 to 3 in which the radiation beam (IB) is focused in the vicinity of the observation region (MR).

7. A method according to Claim 6 in which the position of the observation region (MR) is selected so as to be outside the Rayleigh zone (RZ) close to the position of smallest diameter of the beam (IB).

8. A method according to any one of Claims 1 to 3 in which the radiation is focused by means of a cylindrical lens (2''') so as to form a thin blade of light (4''') which illuminates the observation region (MR) substantially one-dimensionally.

9. A method according to any one of the preceding claims in which the illumination and the detection are performed from opposite sides of the observation region (MR).

10. A method according to any one of the preceding claims, arranged so as to determine the fractional order at the

centre of the system of interference fringes produced by a single particle at a time.

11. A method according to any one of the preceding claims in which the detection of the plurality of radiation intensity values determined by the interference between the scattered radiation (SW) and the transmitted radiation (TB) comprises a measurement of the variation of the intensity values over time upon the passage of a particle (B) through the incident beam (IB),

the determination of the properties of the particle (B) being based on the variation over time of the fringes that are affected by the phase delay.

12. A method according to Claim 11 in which the determination of the properties of the particles (B) presupposes the determination of the position of transit of the particle (B) through the incident beam (IB) by analysis of the asymmetry of the variation over time of the intensity values measured.

13. A method according to Claim 11 in which the measurement of the variation of the intensity values over time takes place by selection of the zone of transit of the particles (B).

14. A method according to any one of Claims 1 to 9 in which the determination of the interference fringe systems associated respectively with the particles (B) comprises a determination of the centres (C_k) of a plurality of interference fringe systems produced by a corresponding plurality of particles (B).

15. A method according to Claim 14 in which the determination of the interference fringe systems associated respectively with the particles (B) comprises a determination of a power

spectrum of the electric field corresponding to the plurality of radiation intensity values.

16. A method according to any one of the preceding claims in which the determination of the properties of the particles (B) on the basis of the lower-order fringes of the system of fringes is programmed in a manner such as to determine the distribution of the dimensions of the particles (B).

17. Apparatus arranged for implementing a measurement method according to Claim 1, comprising:

a source (1; 1''') of the radiation beam (IB), suitable for illuminating the observation region (MR),

sensor means (3; 3''') suitable for detecting the radiation at a plurality of points simultaneously and for making available a signal indicative of the detection, the sensors being disposed on the propagation axis (z) in a manner such as to detect a plurality of radiation intensity values which are determined by the interference between the scattered radiation (SW) and the transmitted radiation (TB), in which the interference is affected by a phase delay of the scattered radiation (SW) relative to the transmitted radiation (TB), the delay being determined by the interaction of the radiation beam (IB) with the particles (B), and

processing means which are programmed to determine, on the basis of the signal, interference fringe systems associated respectively with the individual particles (B), and to determine the properties of the particles (B) on the basis of the fringes which are affected by the phase delay.

18. Apparatus according to Claim 17, further comprising lens means interposed between the observation region (MR) and the sensor means (3; 3''') so as to permit indirect detection by detection of the plurality of intensity values in an optically conjugate plane.

19. Apparatus according to Claim 17 or Claim 18, further comprising a system (2''') for shaping the wave front, based on cylindrical optics such as to form a thin blade of radiation (4''') for the illumination of the observation region (MR).

20. Apparatus according to Claim 17 or Claim 18, further comprising a system (2) for shaping the wave front, suitable for focusing the radiation in the vicinity of the observation region (MR).

21. Apparatus according to Claim 17 to 18, further comprising a system for shaping the wave front, suitable for collimating the radiation that is incident on the observation region (MR).

22. Apparatus according to any one of Claims 17 to 21 in which the sensor means (3; 3''') comprise a CCD, NMOS or CMOS sensor.

23. Apparatus according to any one of Claims 17 to 21 in which the sensor means (3; 3''') comprise a plurality of photodiodes arranged in manner such as to detect, as a function of time, the intensity distribution produced by the interference between transmitted radiation (TB) and scattered radiation (SW).

24. Apparatus according to Claim 23 in which the photodiodes are arranged in a manner such as to pick up selectively radiation coming from predetermined zones of transit of the particles (B).

25. Apparatus according to any one of Claims 17 to 24 in which the source (1; 1''') is a multi-coloured source.